(12) EUROPEAN PATENT APPLICATION

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(54) Document size detection device.

(57) A document size detection device detects the size of documents (N) such as non-US currency and comprises a housing (33), a plate (35) mounted in the housing past which each document is moved, and LED photoelectric sensors (37,38) positioned along and across the plate (35) for sensing the size of each document and for initiating a signal indicating the length and width of each document.

The signals are transmitted to a counting machine, which counts the sheets in response to said signal, and thereby counts the value of the sheets where the latter are currency notes.
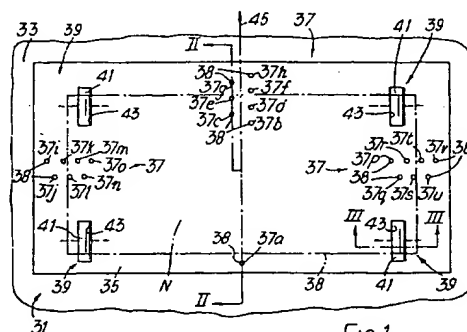
FIG.1a

EP 0 487 316 A2

This invention relates to devices for detecting the size of documents, and more particularly but not exclusively concerns document size detection devices for identifying the size, and therefore the value denominations of paper currency bank notes, where the bank notes have different lengths and/or widths which correspond to different value denominations as in many countries outside the United States.

Machines handle documents such as currency, checks, fool stamps, coupons, and the like at speeds generally in the range of 10 to 150 inches/second. The machines are used for counting, batching, imprinting, reading, sorting, dispensing, etc. The documents are rectangularly shaped sheets which are fed along either of its two axes.

Mixed documents, such as a mixture of German DM notes of different value denominations and different sizes, are difficult to count by machine, such as a counting machine disclosed in U.S. Patent No. 4,737,627, issued on April 12, 1988, which is incorporated herein by reference.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a device and a method for detecting the value of bank notes when the bank notes have different lengths and/or widths which correspond to different value denominations, and for counting a stack of bank notes and determining their total value.

Another object of the invention is to provide a device and a method for detecting the size of documents.

These and other objects are accomplished by providing a housing, a plate mounted in the housing past which each document is moved, and sensor means positioned along the plate for sensing the size of each document and for initiating a signal indicating the size of each document.

The present invention detects and identifies the size of each document in a mixture of different size documents as each document moves over the detection area of the invention moving within a speed range of slow to very fast.

In its simplest form, the invention detects, for example German DM notes moving along their short axis, or width. LED/sensor pairs are placed along the path of the moving documents to detect each of the six different German DM notes.

An embodiment of the invention will now be described by way of example with reference to the drawings, in which:

Fig. 1a is a view in top plan of the detection area of the embodiment.

Fig. 1b is a view in top plan of the detection area of the invention shown in Fig. 1a, showing a document that has been shifted to the right being processed.

Fig. 2 is a view in cross section taken along the lines and arrows II-II of Fig. 1a; and

Fig. 3 is a view in longitudinal section taken along the lines and arrows 1c-1c of Fig. 1a.

Turning to Fig. 1a, a preferred embodiment of the invention is shown which comprises a device 31 for detecting the size of documents such a paper currency notes N which have different lengths or different widths or different lengths and widths which correspond to different value denominations, and for identifying their value denominations. Device 31 comprises a housing 33, a plate 35 mounted in housing 33 past which each note is moved, and sensor means 37 positioned in plate 35 for sensing the size of each note and for initiating a signal indicating the size of each note.

The notes are moved over plate 15 within the speed range of slow to very fast, such as from 10 inches per second to 150 inches per second.

Sensor means 37 include a trailing edge detector 37a for detecting the trailing edge 38 of each note N as each note passes over plate 35. Sensor means 37 also include width detectors 37b, 37c, 37d, 37e, 37f, 37g, and 37h that are spaced in a pattern along plate 35 such that the number of width detectors 37b-37h covered or uncovered by each document corresponds to different designated widths of notes.

Sensor means 37 also includes a plurality of length detectors 37i, 37j, 37k, 37l, 37m, 37n, 37o, 37p, 37q, 37r, 37s, 37t, 37u, and 37v, spaced in a pattern along plate 35 such that the number of length detectors 37i-37v that are covered or uncovered by each note corresponds to a different designated length of the notes.

Width detectors 37b-37h and length detectors 37i-37v are staggered in this embodiment of the invention, as shown in Fig. 1a, to sense notes which have a size change of smaller degree than the German DM notes, that is, to detect, for example, currency which has a size change of only 3mm between notes, such as the widths of some Australian currency.

Detectors 37a-37v comprise LED/sensor pairs positioned normal to the plane of movement of the notes as the notes pass over plate 35, with the first half of each LED/sensor pair mounted in openings formed in plate 35 and the corresponding second half 38 of each LED/sensor pair mounted in housing 33 above plate 35 across from its first half.

The placement of detectors 37a-37v takes into account some skew in the notes as they pass over plate 35, but skew in minimized by keeping the notes under control via conveying means 39 as the notes are moved through the detection area.

Conveying means 39 is mounted along plate 15 for conveying each note over plate 35. Conveying means 39 includes a plurality of driven rollers 41 mounted below plate 35 so as to project above plate 15 through holes 43, that are paired with idler rollers

42 mounted above and in contact with the top surface of driven rollers 41.

Control of each note as it is conveyed over plate 35 is maintained by the placement of the roller pairs (41,42). Both the right side portion and the left side portion of each note as it passes over the detection area plate 15 are in contact with a roller pair (41,42).

In operation, bank notes are fed width-wise sequentially into device 31 over plate 35 in direction of the arrow 45 in Fig. 1a, and each note N is conveyed over plate 35 by the rollers. When the trailing edge of each note N passes beyond trailing edge detector 37a so that the note N no longer covers trailing edge detector 37a, the size of the note is detected by the sensor means 37 by determining the number of width detectors 37b-37h and the length detectors 37i-37v that are covered or uncovered. Detectors 37b-37v spaced such that the number of width detectors 37a-37h and length detectors 37i-37v that are covered provide the identity of the note. The number of detectors covered determines the size and therefore the identity of the bank note.

Device 31 detects and identifies the size of each note passing over the detection area, and the notes may be all one sizes or may be mixture of different sizes. Detectors 37a-37v sense the size of each note sizes by sensing the number of detectors passing over them by sensing the number of detectors 37b-37v that are covered when detector 37a becomes uncovered and initiate a corresponding signal indicating the size of the note. The signal is sent to a control mechanism where each signal, which indicates the specific size and corresponding denomination of the detected note, is registered. Using appropriate counting means, the signals are counted to determine the total value of the notes fed through device 31.

In device 31, as shown in Fig. 1a, when the trailing edge of note N is detected by trailing edge detector 37a, there are 12 detectors 37b, 37c, 37d, 37e, 37l, 37m, 37n, 37o, 37p, 37q, 37r, and 37s covered by note N. However, as shown in Fig. 1b, if a similar size note is fed over plate 35, but, for example, it is shifted and skewed to the right, the correct size of the note is still detected since 12 of the width and length detectors - detectors 37b-37e and detectors 37o-37v - still remain covered by the note.

Again, when the notes are moved through the area of detection along plate 35, the notes are separated from one another so that there is a space between each note larger than the detection area.

The distance between the trailing edge detector 37a and the detector 37b is less than the width of the note having the smallest width of the notes being processed so that, when the trailing edge detector 37a is uncovered, the note covers detector 37b.

The notes are moved through device 31 within the speed range of slow to very fast, such as from 10 inches per second to 150 inches per second.

Although paper currency has been used to illus-

trate the invention, any type of documents may be processed with the inventive document size detection device.

Example Uses

Device 31 may be used to verify that a batch of documents contains sheets all having the same size. For example, a batch of German 50 DM notes may be processed through device 31 to have each document identified to verify that each document in the batch is in fact a German 50 DM note. If a note other than a German 50 DM note is contained in the batch, such as a German 10 DM note, device 31 identifies the non-conforming note (the German 10 DM note contained in the batch of German 50 DM notes), and stops processing the batch so that the non-conforming note (the German 10 DM note) may be removed from the batch.

Device 31 may be used to process a batch of documents containing notes of different sizes. The mixed batch of documents may be processed through device 31 such that the number of each document of a particular size is identified and counted. For example, a mixed batch of German DM notes containing German 20 DM notes, German 50 DM notes, and German 100 DM notes may be processed through size detector device 31 so that the number of each German 20 DM note in the mixed batch is identified and counted, the number of German 50 DM notes is identified and counted, and the number of German 100 DM notes in the mixed batch is identified and counted. Further, the total monetary value of the mixed batch may be counted based on the signals sent to a counting mechanism from the device 31.

The device 31 also may be hooked-up to a sorter such that as device 31 senses the size of each document in a mixed batch of documents being processed through the device 31, a signal is transmitted to a sorter downstream from the device 11 and 31 which sorts the documents by size. For example, a mixed batch of German DM notes containing German 50 DM notes and German 100 DM notes may be processed through the device 31 such that each size note is identified as it moves over the detecting plate 15 or 35 and a signal corresponding to the denomination of the note is sent to the sorter so that the German 50 DM notes may be separated from the German 100 DM notes at the sorter.

Claims

1. A document size detection device for detecting the size of documents such as non-US currency comprising:
   a plate (35) past which the documents (N) are moved, and

sensor means (37,38) positioned along the plate for sensing the length and width of each document and for initiating a signal indicating the length and width of each document (N).

2. A document size detection device according to claim 1, wherein the sensor means includes a plurality of LED sensor pairs (37,38) spaced in a pattern at the plate such that a different designated number of sensor pairs corresponds to different designated sizes of documents.

3. A device according to claim 3, in which a first set of sensor pairs (37,38) extends in a first direction of the plate for sensing the length of each document and a second set of sensor pairs (37,38) for sensing document width extends in a second direction substantially perpendicular to the first direction.

4. A detection device according to claim 3, in which the sensor means further comprising a detector (37a,38a), which is spaced apart from the width sensor pairs in said second direction, for detecting the trailing edge of each document N.

5. A document size detection device according to any of claims 1 to 4, further including means (41,43) for conveying each document over the plate.

6. A machine for counting money in the form of paper currency notes of different sizes as to width and/or length, comprising a document size detecting device according to claim 5, and counting means responsive to the said signal and connected to receive the said signal.

7. A machine according to claim 6, characterized by sorting means responsive to the said signal for sorting the sheets by size.

8. A method of detecting the size of documents like sheets of paper currency comprising the steps of:
     sensing the presence of each sheet,
     identifying the sheet by sensing the width and length of the sheet,
     creating an electrical signal proportionate to the width and length of the sheet,
     transmitting the signal to a counting machine,
     counting the sheets in response to said signal, and
     counting the value of the sheets in response to the signal.

9. A method according to claim 8, further including the step of stopping the process when counting

sheets of uniform size and a sheet of different size passes through the sensing unit.

10. The method of claim 8, further including the step of:
     transmitting a signal to a sorter corresponding to the size of each sheet being identified, and
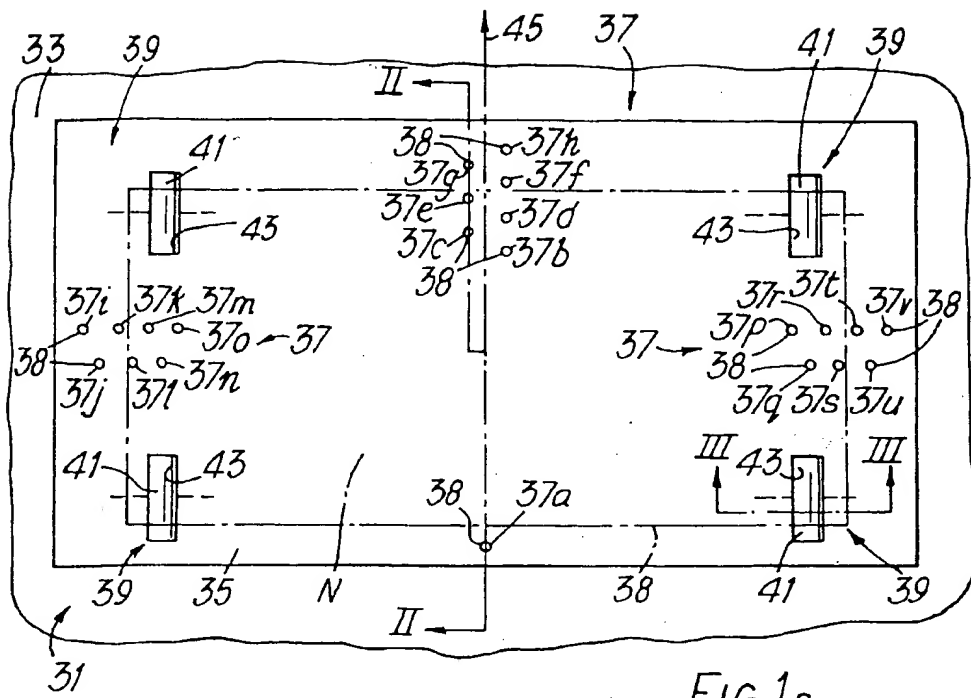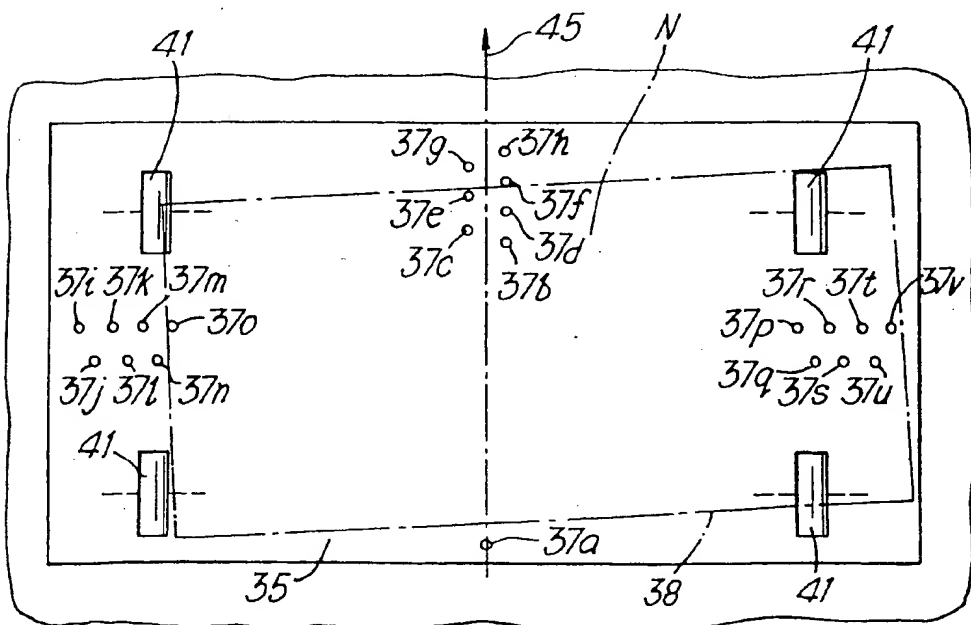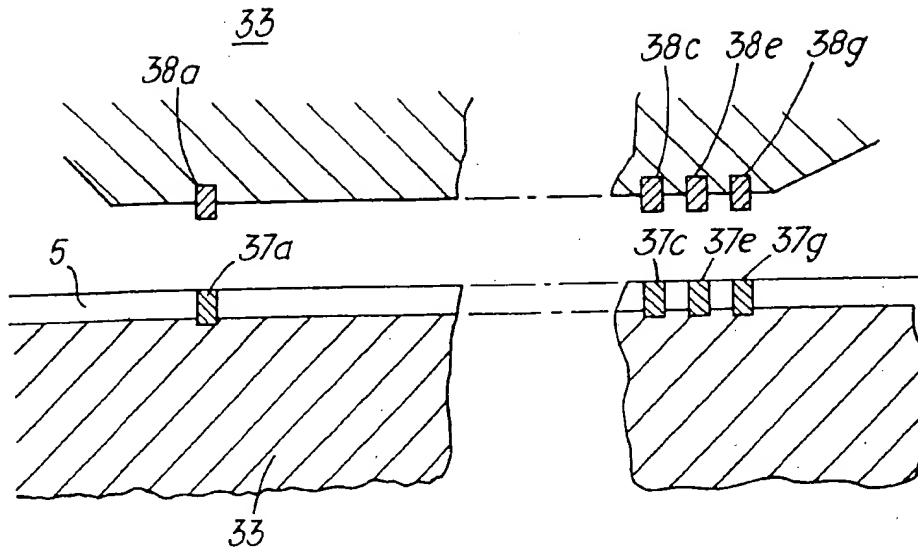   sorting the sheets by size in response to each signal sent to the sorter.
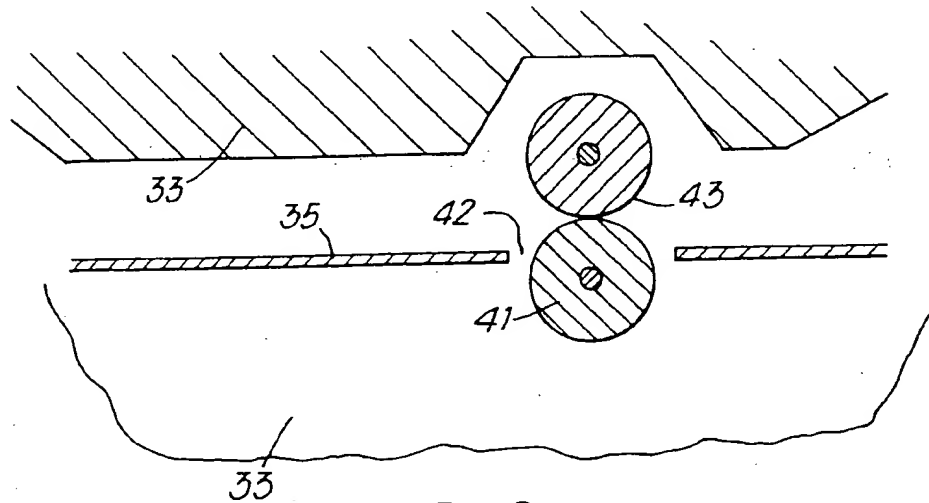
FIG.1a

FIG.1b

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FIG.2

FIG.3

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